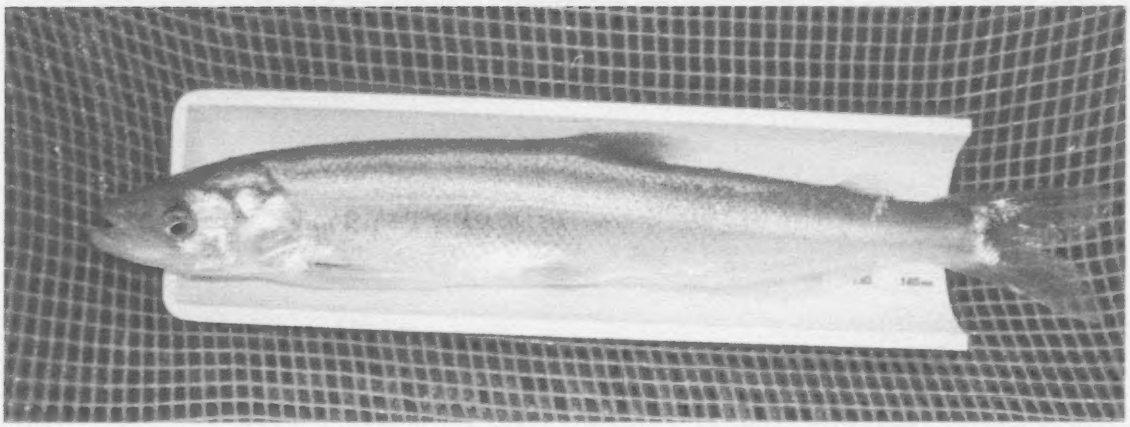
COSEWIC
Assessment and Status Report

on the

Eulachon
Thaleichthys pacificus

Nass/Skeena population

in Canada



SPECIAL CONCERN
2013

COSEWIC
Committee on the Status
of Endangered Wildlife
in Canada

COSEPAC
Comité sur la situation
des espèces en péril
au Canada

COSEWIC status reports are working documents used in assigning the status of wildlife species suspected of being at risk. This report may be cited as follows:

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Previous report(s):

COSEWIC. 2011. COSEWIC assessment and status report on the Eulachon, Nass / Skeena Rivers population, Central Pacific Coast population and the Fraser River population *Thaleichthys pacificus* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. xv + 88 pp. (www.sararegistry.gc.ca/status/status_e.cfm).

Production note:
COSEWIC would like to acknowledge D.E. Hay and M.F. Moody for writing the original draft status report on the Eulachon (*Thaleichthys pacificus*) in Canada, prepared under contract with Environment Canada. This update status report on Eulachon in the Nass and Skeena rivers was written and edited by Alan Sinclair, Co-chair of the COSEWIC Marine Fishes Specialist Subcommittee. Extensive references are made to the original status report (COSEWIC 2011).

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COSEWIC
Assessment Summary

Assessment Summary – May 2013

Common name
Eulachon - Nass/Skeena population

Scientific name
Thaleichthys pacificus

Status
Special Concern

Reason for designation
This short-lived species spends over 95% of its life in the marine environment. It spawns in the lower reaches of two rivers in northern British Columbia where its spawning areas are small (<500 km^2). Recent information from this area indicates the population appears stable and threats in the freshwater environment are considered to be small. However, the abundance of the species in adjacent areas has declined substantially in the recent past. The causes of these declines are poorly understood and are likely to be due to threats in both the spawning habitat and the marine environment. Threats in the marine environment would also affect the Nass and Skeena rivers population. This population could become Threatened in a relatively short period of time if marine survival deteriorates or threats in the spawning area increase.

Occurrence
British Columbia, Pacific Ocean

Status history
Designated Threatened in May 2011. Status re-examined and designated Special Concern in May 2013.

COSEWIC
Executive Summary

Eulachon
Thaleichthys pacificus

Nass/Skeena population

Wildlife Species Information

The Eulachon *(Thaleichthys pacificus)* is a species of smelt (Family Osmeridae, Order Osmeriformes). Eulachon are small fish, usually less than 20 cm total length with an adipose fin and long anal fin. Eulachon migrate to fresh water to spawn, but do not penetrate far upstream. They are mainly a marine species, spending over 95 percent of their lives in the sea. Juvenile Eulachon are difficult to distinguish from other smelt species but in adults there is a distinctive characteristic in the form of a group of concentric lines or 'striae' on the gill cover (operculum).

Distribution

Within the entire range of Eulachon, from northern California to the eastern Bering Sea, there may be fewer than 100 rivers that support regular spawning runs. In British Columbia (BC) they occur in at least 38 rivers but many of these do not have regular spawning runs. A limited amount of genetic research indicates that there is reproductive isolation among some populations. These differences coupled with differences in run timing and location of source waters for Eulachon rivers suggest the species has 3 designatable units in Canada; the Nass/Skeena, the Central Pacific Coast, and the Fraser river.

Habitat

Throughout their range Eulachon spawn mainly in coastal rivers that are associated with glaciers or snowpacks and which contribute to strong spring freshets. There are no established populations spawning in rivers draining coastal islands, such as Vancouver Island, or any others in BC. Mildly adhesive eggs are deposited in spring on river bottom sediments. In most rivers the eggs may move during incubation, so spawning habitats within rivers may encompass much of the river bottom. Incubation time is temperature-dependent and they incubate for about 2-8 weeks in the lower reaches of rivers. Immediately after hatching, yolk sac larvae are rapidly flushed into coastal estuarine waters. In the sea, Eulachon are found on shelf waters usually close to the bottom, often in depths of 50-200m.

Biology

Eulachon have exceptionally high lipid content, with about 20% of the wet weight being fatty tissue. This may be the highest of any known marine fish species. Generally Eulachon go unnoticed during the marine phase of their lives except when they are taken incidentally by trawl gear. The factors controlling their marine distribution are not understood. There are few morphological differences among populations throughout their range. Eulachon are semelparous (i.e. they spawn once then die) and most spawn at age 3.

Population Sizes and Trends

There are no population size estimates or a quantitative index of abundance available for the Nass/Skeena population. However, catches in the Nass River over the past 60 years have averaged approximately 200 t annually with no temporal trend. At an average weight of 34 g per fish, this suggests catch numbers of approximately 4.25 million fish. The catch contains both pre-spawn and post-spawn fish of both sexes. That the catch trend has been stable over a considerable period of time suggests a large number of fish are able to reproduce and thus the annual run size is considerably higher than 4.25 million fish. Over the past 3 years, 2010-2012, the catches have been above average. It should be noted that the current abundance of Eulachon in the Nass River are most likely lower than 150 – 200 years ago. The largest estimated catches were in the range of 2000 t annually in the early 1840s. However, by the early 1900s, annual catches appear to have stabilized at the 200-500 t range.

It is clear that Eulachon abundance in adjacent populations in Canada and the US, including southeast Alaska, have declined considerably in recent years. The Nass/Skeena population is unique in appearing to be relatively stable while other populations have declined.

Threats and Limiting Factors

Eulachon are mainly a marine species, spending more than 95% of their lives in the sea and only using freshwater during spawning, egg, and larval stages. There is little human activity in the reaches of the Nass and Skeena Rivers that is likely to disturb Eulachon spawning. Eulachon are an ideal prey species because of their high lipid content. However, little is known about the effect of predation on Nass and Skeena river Eulachon. Eulachon are caught as bycatch in some fisheries, especially with bottom trawls, and bycatch has been implicated as a threat. However, such bycatch is small relative to Eulachon biomass estimates in the sea. Systematic change in the ocean climate in recent decades cannot be excluded as a plausible explanation for some of the observed reduction in Eulachon abundance in adjacent populations, but the evidence for this is circumstantial.

Special Significance

The Eulachon has a unique and vitally important place in most First Nations communities on the British Columbia coast. The products of Eulachon harvest include fresh, dried, smoked, salted, and frozen whole fish; however, the product of greatest cultural, economic, nutritional, and social value is indisputably called 'grease' or the oil rendered from the fish. Distributed widely in potlatches, traded with neighbouring Nations, and relied upon for its wealth of nutritional and medicinal uses, grease and grease-making has long been a tradition in almost all First Nations with spawning rivers located in their traditional territory.

For the Nisga'a people, the Nass River Eulachon were the 'saviour' fish, arriving to the harvesting areas at a time when food from the previous year's fishing, hunting and gathering was becoming depleted. The Nisga'a Obiyee (New Year) starts during the spring equinox with the migration of Eulachon into the lower Nass River (Ksi Lisims). To this day, the Nass River Eulachon fishery is still managed under the traditional Nisga'a laws governing resource use.

Existing Protection, Status, and Ranks

The Province of British Columbia 'blue' listed Eulachon in 2000 and maintained the listing when it was reviewed in 2004. It is not clear if this listing has resulted in any action to address the imminent threats.

Eulachon has not been assessed by the International Union for Conservation of Nature (IUCN).

On March 16, 2010, the United States announced that it was listing the southern Eulachon DPS (distinct population segment) as threatened under the ESA (*Endangered Species Act*).

Since 1995, Fisheries and Oceans Canada (DFO) has taken five specific actions to protect Eulachon: (i) suspension of commercial Eulachon fisheries in the Fraser River; (ii) suspension of dredging during the Eulachon spawning season in the lower Fraser River; (iii) closure of the shrimp fishery in Queen Charlotte Sound; (iv) adoption of 'Eulachon action levels' by DFO management that warn of possible shrimp fishing closures when the allowed cumulative Eulachon bycatch level is reached; (v) requirement of mandatory 'BRD's – or 'bycatch reduction devices' installed in shrimp trawls to reduce fish by-catch.

In response to Nisga'a concerns, commencing in 2008 DFO also closed the shrimp trawl fishery in those waters of Subareas 3-12 and 3-18 from February 1 to March 31 to avoid interaction with schooling adult Eulachon returning to spawn in the Nass River. This closure is to be reviewed annually with industry and First Nations, considering expected Eulachon returns.

TECHNICAL SUMMARY – Nass/Skeena population

Thaleichthys pacificus
Eulachon
Nass/Skeena Rivers population
Range of Occurrence in Canada : British Columbia, Pacific ocean

Eulakane
Population des rivières Nass et Skeena

Demographic Information

Generation time (usually average age of parents in the population; indicate if another method of estimating generation time indicated in the IUCN guidelines(2008) is being used)	3 yrs
Is there an [observed, inferred, or projected] continuing decline in number of mature individuals?	No
Estimated percent of continuing decline in total number of mature individuals within [5 years or 2 generations]	Stable
[Observed, estimated, inferred, or suspected] percent [reduction or increase] in total number of mature individuals over the last [10 years, or 3 generations].	Stable
[Projected or suspected] percent [reduction or increase] in total number of mature individuals over the next [10 years, or 3 generations].	Not estimated
[Observed, estimated, inferred, or suspected] percent [reduction or increase] in total number of mature individuals over any [10 years, or 3 generations] period, over a time period including both the past and the future.	Not estimated
Are the causes of the decline clearly reversible and understood and ceased?	N/A
Are there extreme fluctuations in number of mature individuals?	No

Extent and Occupancy Information

Estimated extent of occurrence	Unknown
Index of area of occupancy (IAO) (Always report 2x2 grid value).	156 km^2
Is the population severely fragmented?	No
Number of locations*	N/A
Is there an [observed, inferred, or projected] continuing decline in extent of occurrence?	N/A
Is there an [observed, inferred, or projected] continuing decline in index of area of occupancy?	No
Is there an [observed, inferred, or projected] continuing decline in number of populations?	No
Is there an [observed, inferred, or projected] continuing decline in number of locations*?	N/A
Is there an [observed, inferred, or projected] continuing decline in [area, extent and/or quality] of habitat?	No
Are there extreme fluctuations in number of populations?	No
Are there extreme fluctuations in number of locations*?	N/A
Are there extreme fluctuations in extent of occurrence?	N/A
Are there extreme fluctuations in index of area of occupancy?	No

Number of Mature Individuals (in each population)

Population	N Mature Individuals
Based on an average catch of 200 t and an average weight of 34 g	
Total	> 4,000,000

Quantitative Analysis

Probability of extinction in the wild is at least [20% within 20 years or 5 generations, or 10% within 100 years].	Not Done

Threats (actual or imminent, to populations or habitats)

Eulachon are mainly a marine species, spending more than 95% of their lives in the sea and only using freshwater during spawning, egg, and larval stages. There is little human activity in the lower reaches of the Nass and Skeena Rivers that is likely to disturb Eulachon spawning. Eulachon are an ideal prey species because of their high lipid content. However, little is known about the effect of predation on Nass and Skeena River Eulachon. Eulachon are caught as bycatch in some fisheries, especially with bottom trawls, and bycatch has been implicated as a threat. However, such bycatch is small relative to Eulachon biomass estimates in the sea. Systematic change in the ocean climate in recent decades cannot be excluded as a plausible explanation for some of the observed reduction in Eulachon abundance in adjacent populations, but the evidence for this is circumstantial.

Rescue Effect (immigration from outside Canada)

Status of outside population(s)?	Populations in Southeast Alaska are considered to be in poor condition as are other populations in Canada. Little is known about linkages between Eulachon populations across the Canada/USA (Alaska) border
Is immigration known or possible?	No
Would immigrants be adapted to survive in Canada?	Yes
Is there sufficient habitat for immigrants in Canada?	Yes
Is rescue from outside populations likely?	No

Data Sensitive Species

Is this a data sensitive species?	No

Status History

Designated Threatened in May 2011. Status re-examined and designated Special Concern in May 2013.

Status and Reasons for Designation:

Status:	**Alpha-numeric code:**
Special Concern	N/A

Reasons for designation:

This short-lived species spends over 95% of its life in the marine environment. It spawns in the lower reaches of two rivers in northern British Columbia where its spawning areas are small (<500 km^2). Recent information from this area indicates the population appears stable and threats in the freshwater environment are considered to be small. However, the abundance of the species in adjacent areas has declined substantially in the recent past. The causes of these declines are poorly understood and are likely to be due to threats in both the spawning habitat and the marine environment. Threats in the marine environment would also affect the Nass and Skeena rivers population. This population could become Threatened in a relatively short period of time if marine survival deteriorates or threats in the spawning area increase.

Applicability of Criteria

Criterion A (Decline in Total Number of Mature Individuals): Does not apply. Recent run sizes appear to be stable.
Criterion B (Small Distribution Range and Decline or Fluctuation): Does not apply. Recent run sizes and habitat appear to be stable.
Criterion C (Small and Declining Number of Mature Individuals): Does not apply, population size exceeds threshold.
Criterion D (Very Small or Restricted Population): Does not apply.
Criterion E (Quantitative Analysis): Not done.

PREFACE

Eulachon in Canada were first assessed by COSEWIC in May 2011. Three designatable units (DU) were assessed, the Nass/Skeena, the Central BC Coast, and the Fraser River. An abundance index based on the First Nations fishery catch per unit effort was an important component of the Nass/Skeena assessment. The index indicated there had been a decline of 48% in catch per unit effort over three generations. Although not statistically significant ($p=0.24$), this observation contributed to a recommended status of Threatened for this population. Subsequent to the COSEWIC meeting, the Chair of COSEWIC received a letter from the Nisga'a Lisims Government (Stevent, H.M. 2011 pers. comm.) that asserted Eulachon in the Nass and Skeena rivers should be separate DUs and that the fishing effort data used in the catch per unit effort index was not appropriate for this purpose. This information was not available to COSEWIC at the time of the original assessment and had the potential to alter the recommended status. According to Section 24 of *SARA*, COSEWIC must review the classification of a wildlife species if there is reason to believe its status might have changed. COSEWIC, therefore, reviewed the new information at its November, 2011 Species Assessment Meeting and concluded that that the original population structure grouping Eulachon in the Nass and Skeena rivers as a single DU was appropriate, but that a change in status was possible given the new information regarding fishing effort. As a result, COSEWIC agreed that the Nass/Skeena Population of Eulachon should be reassessed.

This report contains the information needed for the reassessment. It makes extensive reference to the original COSEWIC assessment for sections on Species Information, Distribution, and Biology. The sections on Population Sizes and Trends, Rescue Effect, Threats and Limiting Factors have been rewritten to include up-to-date and appropriate information on the Nass/Skeena populations. The contributions of Cheryl Stephens of the Nisga'a Lisims Government and Robert Bocking of LGL Limited to this report are gratefully acknowledged.

COSEWIC HISTORY

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) was created in 1977 as a result of a recommendation at the Federal-Provincial Wildlife Conference held in 1976. It arose from the need for a single, official, scientifically sound, national listing of wildlife species at risk. In 1978, COSEWIC designated its first species and produced its first list of Canadian species at risk. Species designated at meetings of the full committee are added to the list. On June 5, 2003, the *Species at Risk Act* (SARA) was proclaimed. SARA establishes COSEWIC as an advisory body ensuring that species will continue to be assessed under a rigorous and independent scientific process.

COSEWIC MANDATE

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) assesses the national status of wild species, subspecies, varieties, or other designatable units that are considered to be at risk in Canada. Designations are made on native species for the following taxonomic groups: mammals, birds, reptiles, amphibians, fishes, arthropods, molluscs, vascular plants, mosses, and lichens.

COSEWIC MEMBERSHIP

COSEWIC comprises members from each provincial and territorial government wildlife agency, four federal entities (Canadian Wildlife Service, Parks Canada Agency, Department of Fisheries and Oceans, and the Federal Biodiversity Information Partnership, chaired by the Canadian Museum of Nature), three non-government science members and the co-chairs of the species specialist subcommittees and the Aboriginal Traditional Knowledge subcommittee. The Committee meets to consider status reports on candidate species.

DEFINITIONS
(2013)

Wildlife Species	A species, subspecies, variety, or geographically or genetically distinct population of animal, plant or other organism, other than a bacterium or virus, that is wild by nature and is either native to Canada or has extended its range into Canada without human intervention and has been present in Canada for at least 50 years.
Extinct (X)	A wildlife species that no longer exists.
Extirpated (XT)	A wildlife species no longer existing in the wild in Canada, but occurring elsewhere.
Endangered (E)	A wildlife species facing imminent extirpation or extinction.
Threatened (T)	A wildlife species likely to become endangered if limiting factors are not reversed.
Special Concern (SC)*	A wildlife species that may become a threatened or an endangered species because of a combination of biological characteristics and identified threats.
Not at Risk (NAR)**	A wildlife species that has been evaluated and found to be not at risk of extinction given the current circumstances.
Data Deficient (DD)***	A category that applies when the available information is insufficient (a) to resolve a species' eligibility for assessment or (b) to permit an assessment of the species' risk of extinction.

* Formerly described as "Vulnerable" from 1990 to 1999, or "Rare" prior to 1990.

** Formerly described as "Not In Any Category", or "No Designation Required."

*** Formerly described as "Indeterminate" from 1994 to 1999 or "ISIBD" (insufficient scientific information on which to base a designation) prior to 1994. Definition of the (DD) category revised in 2006.

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The Canadian Wildlife Service, Environment Canada, provides full administrative and financial support to the COSEWIC Secretariat.

COSEWIC Status Report

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Eulachon

Thaleichthys pacificus

Nass/Skeena population

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Figure 3. Trends in offshore biomass indices from (a) the west coast of Vancouver Island shrimp survey, (b) the Queen Charlotte Sound shrimp survey, and (c) the Hecate Strait groundfish assemblage survey. The insert in Panel A show the approximate geographic areas for the three biomass estimates. Figures (a) and (b) are adapted from DFO (2009). Figure (c) is from Sinclair *et al.* (2007). 7

Figure 4. First Nations catch (t) of Eulachon in the Nass River, 1953-2012. Catch data were not available for years with missing bars. Data from 1953-1996 were taken from Moody (2008), and data for 1997 – 2012 were provided by LGL Limited. 10

WILDLIFE SPECIES INFORMATION

See COSEWIC (2011).

The Nisga'a Lisims Government (Stevens, H.M. 2011 pers. comm.) asked that COSEWIC consider that the Nass River Eulachon should be in a separate designatable unit (DU) from the Skeena based on genetic data in Beacham *et al.* 2005 and what has been done in the US (Department of Commerce 2010, Gustafson *et al.* 2012).

In the US, Eulachon are considered to exist in two Distinct Population Segments (DPS), a species designation similar to COSEWIC's designatable unit (DU) (Department of Commerce 2010, Gustafson *et al.* 2012). A southern DPS is located in the conterminous US between northern California and south of the Nass River (and north of the Skeena). The northern DPS includes the Nass and Alaska rivers. Thus, the US assessment placed the Nass and Skeena rivers in separate DPSs. The available genetic data (mainly Beacham *et al.* 2005) and aspects of life history and biogeography were considered. Gustafson *et al.* 2011 note that the boundary between the southern and northern DPS is unclear and further research could lead to an alternative structure. A large determining factor in their paper was biogeographic, the boundary between the Alaska Coastal Downwelling Province and the transition zone between the Alaska and California currents. In their Figure 1, this boundary hits land between the mouths of the Nass and Skeena Rivers, even though the oceanographic process in question occurs well offshore and further south. They did not consider any further structure in Alaska since they were petitioned only to consider Eulachon in the conterminous US. As long as the boundary between the southern and northern DPS was somewhere in Canada, its precise location was moot (see Q&A in Department of Commerce 2010). They also concluded that a DPS structure where all eulachon rivers were distinct and significant was untenable.

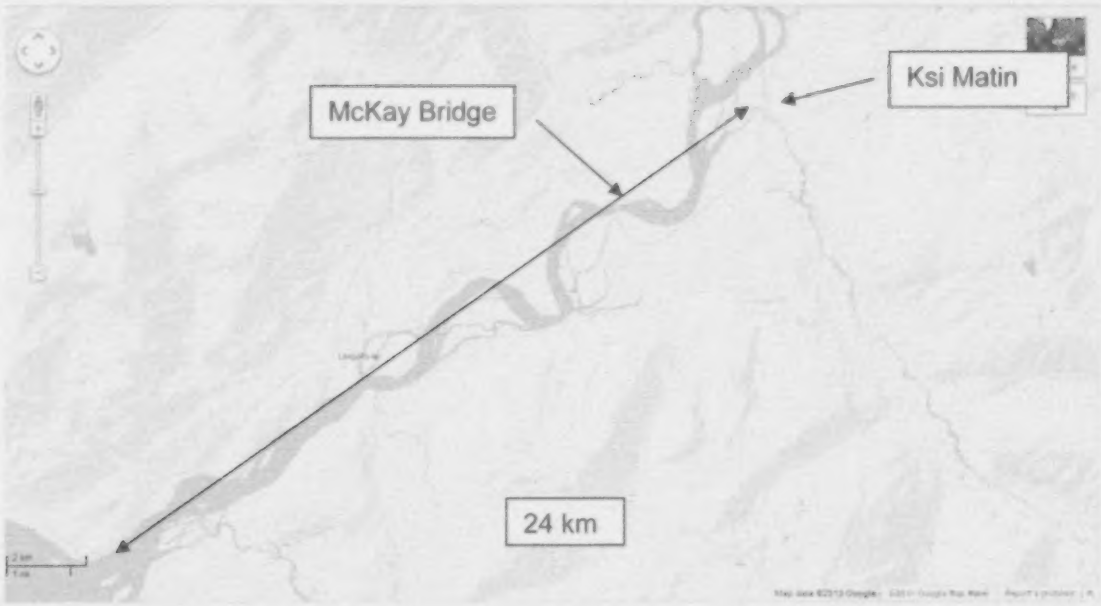

Figure 1. Spawning area for Eulachon in the Nass River, a linear distance of 24 km.

COSEWIC used the same genetic data (Beacham *et al.* 2005) and a different biogeographic argument, that both rivers drain from the BC interior while the Central Coast DU rivers drain from the coastal mountains, when it grouped these 2 rivers (Nass and Skeena) together (COSEWIC 2011). At its November 2011 meeting, COSEWIC concluded that there was no new information that would lead to a change in the recommended DU structure for Eulachon in Canada.

DISTRIBUTION

See COSEWIC (2011).

HABITAT

See COSEWIC (2011).

Eulachon are believed to spawn in the Nass River from the estuary to as far upriver as the mouth of the Ksi Matin River, a reach of approximately 24 km (Noble *et al.* 2012, Figure 1). Eulachon spawn in the main stem of the Skeena River from the estuary to an upstream reach of approximately 17.5 km (Rolston 2010, Figure 2). Dependable spawning runs also occur in two tributaries of the Skeena River, the Ecstalls (30 km) and the Khyex (6.4 km). This is a total of 78 km of river where spawning occurs.

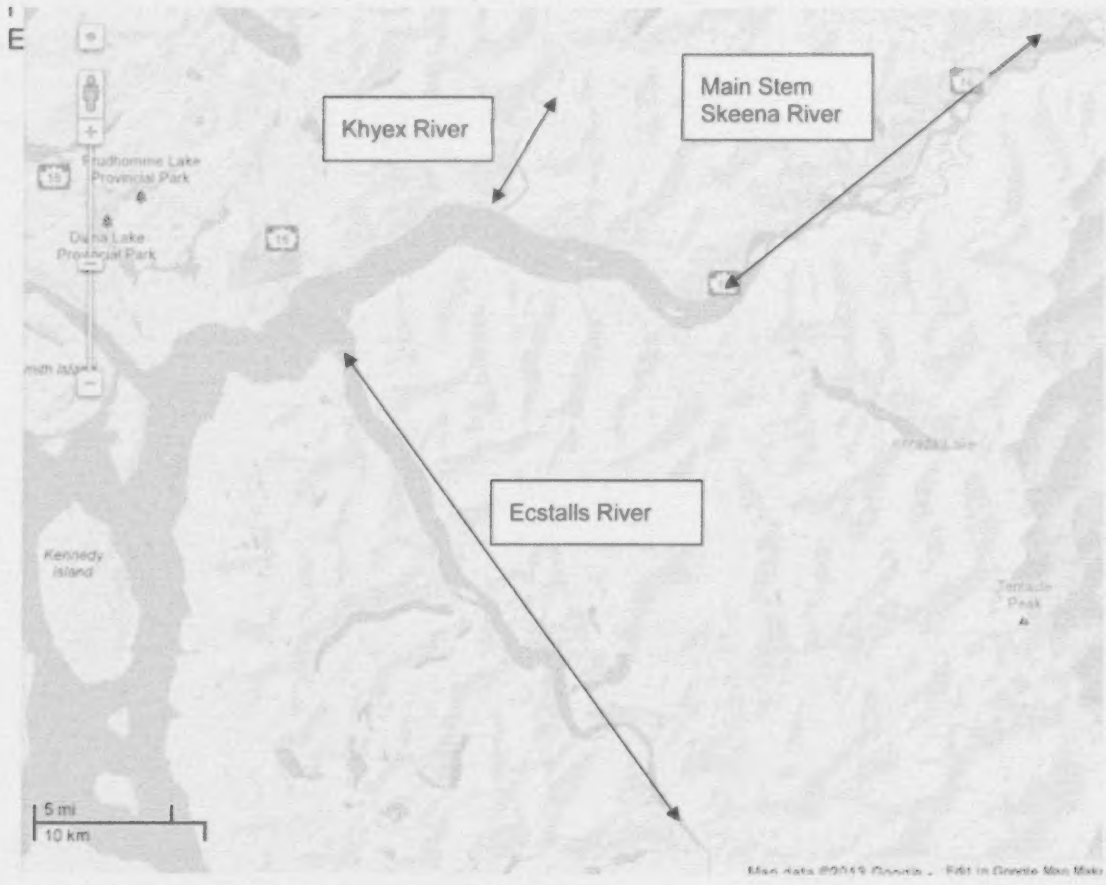

Figure 2. Eulachon spawning areas in the Skeena River (17.5 km) and its tributaries the Ecstalls (30 km) and Khyex (6.4 km) rivers.

The index of area of occupancy (IAO) is based on the smallest area required to complete the life cycle of the species (COSEWIC O&P Manual). In the case of Eulachon, this would be the spawning area. A rough approximation of the IAO using a 2 km by 2 km grid may be obtained by multiplying the linear reach of river by 2, giving a total of 156 km^2.

BIOLOGY

See COSEWIC (2011).

POPULATION SIZES AND TRENDS

The 2011 COSEWIC assessment of Eulachon in the Nass/Skeena population included a time series of catch per unit effort that was used as an index of abundance in the application of the A criterion. Following the assessment, COSEWIC received information from the Nisga'a Lisims Government that the fishing effort data (hours fished in Table 5 of COSEWIC 2011) used in the assessment was inappropriate for that purpose, and the effort data were not intended for this use. A number of reasons were given. There was no accounting for differences in gear usage among years. There was no accounting for differences in net size and the size of the net openings. The reported hours did not account for the number of nets used, rather it is the number of hours fished regardless of the actual number of nets tended. In each year, some fishers fished two nets. Hence, the effort data included in the original status report were incorrect. It was not possible to adjust the effort time series to account for this variability.

Abundance trends offshore

Estimates of Eulachon biomass are available from shrimp surveys in areas off the west coast of Vancouver Island and Queen Charlotte Sound (DFO 2009) and groundfish surveys in Hecate Strait (Sinclair *et al.* 2007). This latter area is the closest to the mouths of the Nass and Skeena rivers.

Indices of Eulachon abundance in three areas off the west coast of Vancouver Island were relatively low and variable from 1973 – 1993 (Figure 3a). The indices were low from 1994 – 1999 and then increased considerably to peak in all areas in 2003. The indices then declined to levels similar to the 1980s. The time series for Queen Charlotte Sound is shorter, beginning in 1998. However the pattern is similar to that from the west coast of Vancouver Island with peak abundance in 2001 – 2003 (Figure 3b). The time series for groundfish surveys in Hecate Strait covered 1984 – 2003 (Figure 3c). Eulachon abundance estimates were low from 1984 to 1995, but increased to a maximum value in the last year of the survey in 2003 (Sinclair *et al.* 2007), similar to what was observed in the other (shrimp) surveys.

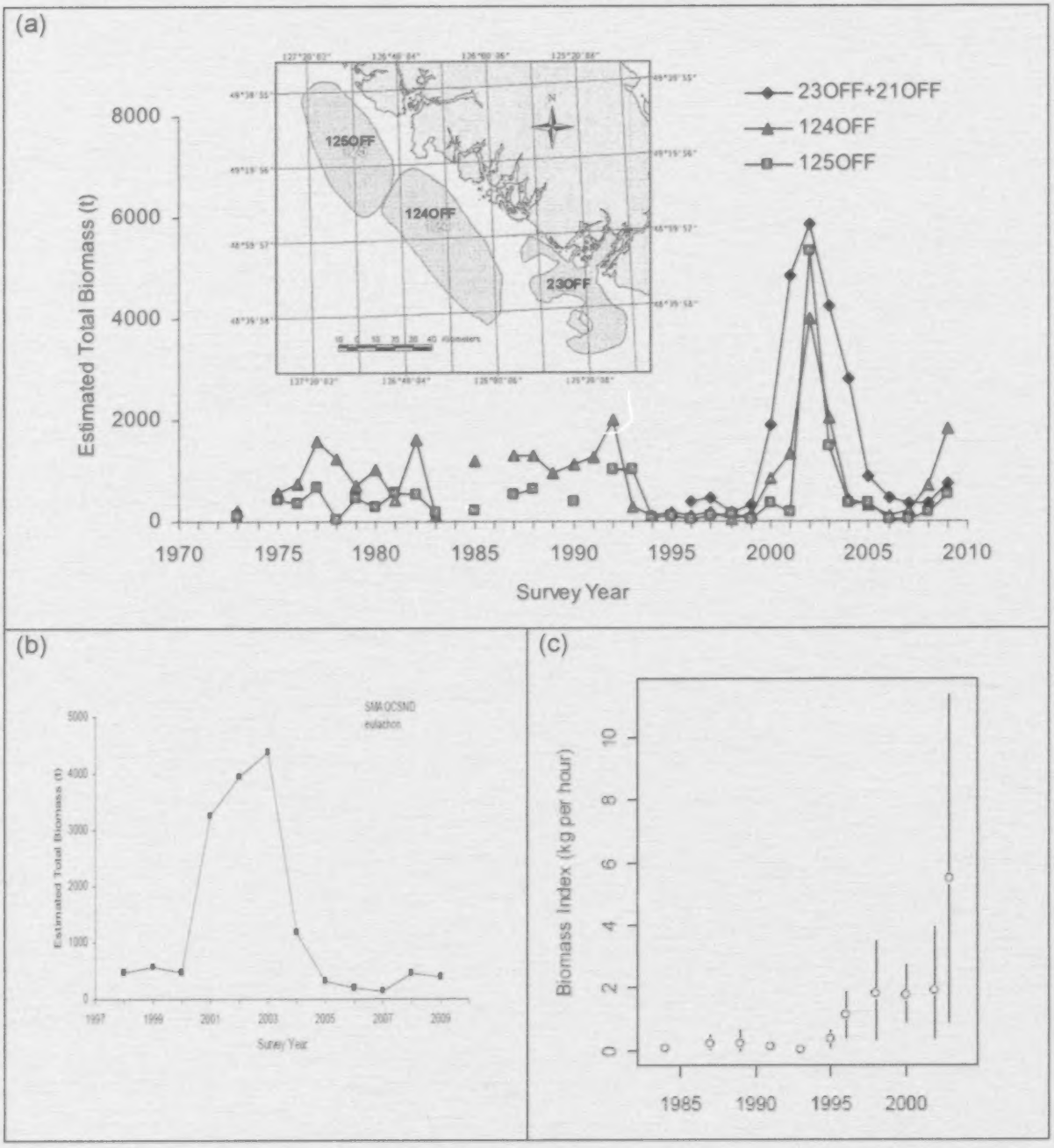

Figure 3. Trends in offshore biomass indices from (a) the west coast of Vancouver Island shrimp survey, (b) the Queen Charlotte Sound shrimp survey, and (c) the Hecate Strait groundfish assemblage survey. The insert in Panel A show the approximate geographic areas for the three biomass estimates. Figures (a) and (b) are adapted from DFO (2009). Figure (c) is from Sinclair *et al.* (2007).

The origin of Eulachon caught offshore was described by Beacham *et al.* (2005). Their genetic analyses indicated that most Eulachon taken off the west coast of Vancouver Island were from the Columbia and Fraser rivers, with some from other rivers. Eulachon captured in Queen Charlotte Sound (off the central coast of British Columbia) were primarily from adjacent spawning rivers. Those caught off the northern coast of British Columbia, including Hecate Strait, came primarily from the Nass, Skeena, Kemano, and Bella Coola rivers.

Trends in the offshore indices of abundance do not match trends in spawning abundance in adjacent rivers (COSEWIC 2011). In particular, spawning abundance did not increase in rivers with appropriate data in the Central Coast and Fraser River during 2001-2004 as would have been expected from the peak in offshore indices. It is difficult to explain these differences in trend. Offshore catches mainly comprise two immature age groups that would have remained in the marine environment for another 1 to 2 years before maturing and returning to fresh water to spawn. Thus, these cohorts could have experienced substantial and variable mortality at sea after the offshore surveys occurred. The offshore surveys were not designed for Eulachon and may not be an effective tool to measure their abundance. A better understanding of the reasons for the discrepancy between offshore indices and spawning abundance estimates may be especially important to understanding factors affecting Eulachon survival. However, this report will focus mainly on estimates of the spawning population abundance and trends.

Abundance in the Nass/Skeena

There are three Eulachon rivers in this DU, Bear, Nass, and Skeena. The status of this DU was determined based on information from the Nass and Skeena Rivers because very little is known about Eulachon in the Bear River, and the runs there are not regular (Anon. 2006).

The Nass River in Northern BC has one of the largest Eulachon runs and it is fished mainly by the Nisga'a people. The Nass run arrives around early to mid-March, but a possible second run might arrive in early April (Langer *et al.* 1977; Noble *et al.* 2012). River conditions vary from year to year during the Eulachon season, and fluctuate between completely free of ice to complete ice coverage. Fishing success in this area depends on the weather and ice conditions. During years with ice cover, Eulachon are harvested through the solid ice with large conical nets but if the ice is too thin or breaks up during the Eulachon run, fishing stops until the ice is cleared and the fishing is then resumed from boats (McNeary 1974; Noble *et al.* 2012). The current fishery is conducted from 7 camps on a specific stretch of the river. Six camps are occupied by members of the Nisga'a First Nation and one by members of the Tsimshian First Nations (Noble *et al.* 2012). Each camp has a pit for fermenting the catch in preparation for the production of grease, which is the first priority. The remainder of the catch is used for fresh consumption or dried and stored for later use. Recently, additional catch has been taken by a Tsimshian fishing from a vessel. Catch surplus to the needs of the Nisga'a is traded with other First Nations.

The Nass River has supported large catches of Eulachon, both by Nisga'a for domestic use and trade as well as a commercial fishery in the early 1900s. In the early 1840s it was reported "the Tsimshians brought more that 30,000 gallons of oolachan oil to Fort Simpson annually" (Gibson 1992). If this amount is converted to tonnes of fresh Eulachon, using the parameter 14.08 gallons/t of fresh Eulachon (Moody 2008) this would equal approximately 2,100 t of Eulachon. This is probably an accurate estimate for this time period, as others reported that the "Indian fishermen land[ed] thousands of tons" of Eulachon a year (Collison 1916). By the early 1900s, annual catches appear to have stabilized at the 200-500 t range (Moody 2008). By the mid 1900s, commercial sale of Nass River Eulachon had stopped.

There are currently no biomass estimates for the Nass River Eulachon spawning population.

Catch estimates in the Nass River from the 1950s to present were obtained from Moody (2008) for 1953-1995, and Noble *et al.* (2012) for 1997-2012. These are plotted in Figure 4. Several years are missing data and could not be plotted. The low value in 2006 was due to heavy ice in the river. There was considerable interannual variation in reported catch with an overall mean of 208 t (sd 102 t). The annual catch in the period 1953-1989 was 227 t, and slightly higher than the average in the period 1990-2009 (154 t). A t-test of the difference in average catch between the two time periods was not statistically significant (p=0.20). However, the catches in the last 3 years (2010-2012) were among the highest in the time period, averaging 325 t. A mixture of pre-spawn and post-spawn animals of both sexes is caught in the Nass fishery. Since 1953, the annual average catch was approximately 200 t. Nass River Eulachon have displayed a wide weight distribution, ranging from less than 15 grams to over 90, with an overall median value of 34 grams, and annual median weights varying from 22 to 40 grams (Noble *et al.* 2012). With an average weight of 34 g per fish (Noble *et al.* 2012), this indicates catch numbers of approximately 4.25 million, on average.

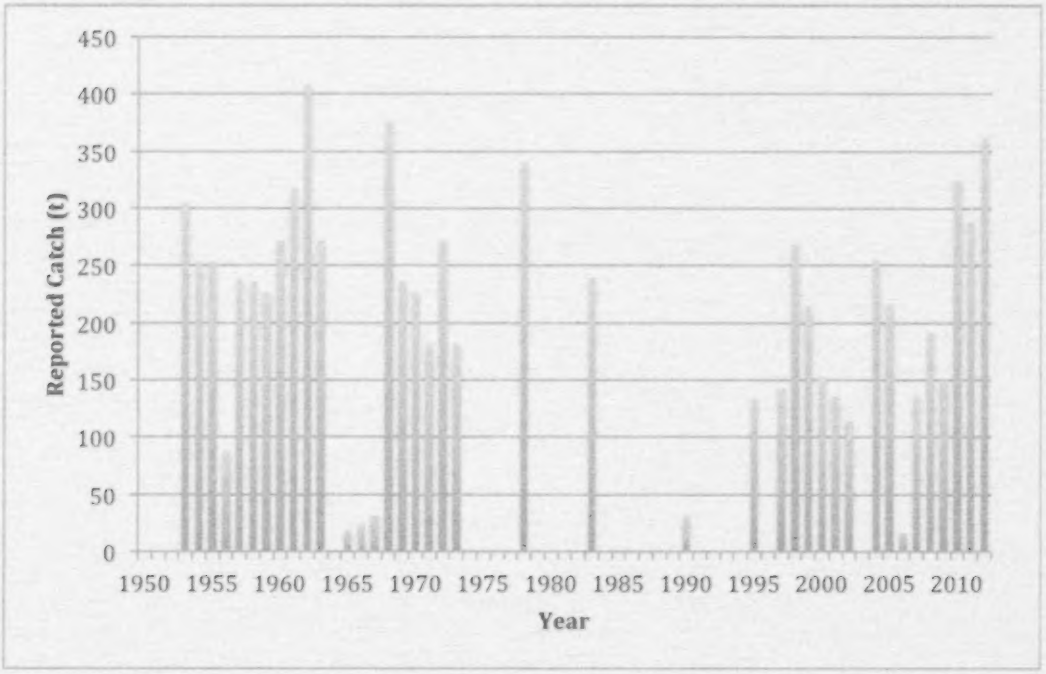

Figure 4. First Nations catch (t) of Eulachon in the Nass River, 1953-2012. Catch data were not available for years with missing bars. Data from 1953-1996 were taken from Moody (2008), and data for 1997 – 2012 were provided by LGL Limited.

Several factors affect the annual catches. In addition to weather and ice conditions mentioned above, the annual harvest is also affected by the number of active camps, the number of Nisga'a crew working in each camp, as well as demand for the harvest product within and outside the Nisga'a Nation.

Available information indicates that spawning population sizes in the Nass River have been stable. Moody (2008) concluded that Nass Eulachon abundance was stable in recent years based on diverse sources of quantitative data from scientific surveys, reports and literature and qualitative or semi-qualitative records from interview surveys or historical archives. In the period since 1996 when a dedicated catch monitoring program was established by the Nisga'a, and with the exception of 2006 when ice conditions were unfavourable for fishing, the needs of the Nisga'a were always met. Low run sizes did not interfere with obtaining enough fish for immediate needs (C. Stephens, pers. com. 2012).

From 1924-1946, the Canadian Bureau of Statistics recorded commercial Eulachon harvests from the Skeena area. These catches ranged from 17.3 t in 1924 to 1.0 t in 1935 (Canadian Bureau of Statistics 1917-1976). All other Eulachon fisheries in this area were traditionally conducted by members of the Tsimshian First Nation, whose members include: Metlakatla, Lax Kw'Alaams, Kitsumkalum and Kitselas Bands (Ryan 2002). The Ecstall River was the only river harvested by the Tsimshian for the production of Eulachon grease because they were said to be of a different or 'better' quality than the Skeena Eulachon (Don Roberts, Kitsumkalum member, pers. comm. 2006). Experienced harvesters from the area report that the run was historically small and short-lived and Tsimshian members usually obtained most of their Eulachon from the Nass River (Roberts 1997). During the 1950s Prince Rupert Fisheries Officers reported that Eulachon of the Skeena and Ecstall rivers were "not fished commercially or for food purposes" (DFO 1941-73).

The Skeena River is the second largest river in BC but it is difficult to monitor for Eulachon. According to Lewis (1997) the Skeena River run has historically been very short lived and difficult to harvest. The Eulachon historically returned to the Skeena during the first week of March, however, in the past decade, it has occasionally returned earlier, during mid to late February (Don Roberts, Kitsumkalum member, pers. comm. 2006). By the mid 1990s the run to the Skeena area noticeably declined, with very few Eulachon observed or caught between 1997 and 1999 (Don Roberts, Kitsumkalum member, pers. comm. 2006). It has also been noted that spawning in upstream areas has diminished. A study on Eulachon life history, habitat use and spawner abundance was conducted on the Skeena River during the 1997 season; the run was estimated at 3.0 t (Lewis 1997). Beginning in 2000, the Tsimshian Tribal Council monitored the status of the Skeena Eulachon using plankton tows for the capture of eggs and larvae and gillnets to capture adults. The crew also monitored the water temperature and the salinity of all three rivers. Relative to a 10-year period before 2007, a "good" run was observed in the area in 2005, but, in 2006, there was virtually no run to the Skeena River (Don Roberts, Kitsumkalum member, pers. comm. 2007). More recently, run sizes have become strong again, comparable to what was seen in the 1930s. The 2010 run was said to be very good and comparable to large runs in the 1930s. The 2011 and 2012 runs were also good (Don Roberts, Kitsumkalum member, pers. comm. 2012).

Eulachon abundance in the Nass River seems to be relatively high compared to other areas of the BC coast. However, 150-200 years ago the Nass supported annual catches nearly ten times those over the past 60 years. The number of Nisga'a and non-Nisga'a fishermen participating in the fishery was likely much larger in the 1800s and early 1900s and so the higher historical catches could simply be a function of greater fishing effort. Moody (2008) and local knowledge both indicate the Nass River population has been stable recently.

Rescue Effect

Little is known about linkages between Eulachon populations in Alaska and those in the Nass/Skeena DU. However, all fisheries for Eulachon in rivers in Southeast Alaska have been closed for several years due to low run sizes (USDA Forestry Service 2012). Thus it is unlikely that rescue could occur from populations to the north. Genetic data indicate a high degree of separation between Eulachon in the Columbia River and those in Canada (Beacham *et al.* 2005). In any case, populations in Washington State are in a depressed condition so that rescue from populations to the south is unlikely (Appendix 1 of COSEWIC 2011).

Threats and Limiting factors

When considering 'threats' to Eulachon it is important to remember that they are mainly a marine species, spending more than 95 % of their lives in the sea and only using freshwater during spawning and egg incubation periods. In a few rivers there also may be a short larval period, but in most rivers newly hatched larvae are flushed to the sea very soon after hatching. It is simple to identify 'potential' threats and limitations in freshwater habitats but it is unlikely such threats, although often valid, would explain the nearly synchronous coast-wide decline of Eulachon that occurred in the early 1990s. It also would not explain why Eulachon in some rivers, with virtually pristine spawning habitats, have declined. Furthermore, the discontinuity between offshore indices of juvenile Eulachon abundance and indices of spawning abundance in coastal rivers suggests that variations in marine survival may be an important threat.

Spawning habitat

Spawning habitat is probably not limiting in most river systems. However, it is difficult to identify and classify Eulachon spawning habitat in some rivers because it seems that the fertilized eggs (embryos) are spatially dynamic, and move (or 'tumble') downstream in rivers. There is little human activity in the lower reaches of the Nass River that is likely to disturb Eulachon spawning habitat there. The spawning distribution in the lower Nass River has not changed over recent decades.

Predation

Eulachon have the highest-known lipid content of any marine fish species (Payne *et al.* 1999) so they make ideal prey and the concentrations of predators around migrating Eulachon runs is spectacular (Marston *et al.* 2002). However, little is known about the effect of predation on Nass and Skeena River Eulachon.

Marine survival, fisheries interception and bycatch

The ocean phase in the life cycle of Eulachon is the probable period when impacts have resulted in their decline. The discontinuity between offshore indices of juvenile Eulachon abundance and within river indices of spawning biomass indicates that mortality in the marine environment may be very important in determining the viability of the species. Eulachon aggregate in the sea and probably this is the main time when density-dependent, abundance-limiting factors become important. That phase in the life of a Eulachon is also relatively long – from the juvenile age of several months to the pre-spawning age of 3 years - allowing plenty of time for Eulachon populations to experience significant mortality. During this time Eulachon are found mainly in shelf waters, near bottom, probably feeding on zooplankton. There seems to be a physical association with shrimp distributions, and Eulachon are routinely taken as bycatch in shrimp trawls (Hay *et al.* 1997).

The rates of Eulachon bycatch in offshore shrimp fisheries were examined in several DFO reports (Hay *et al.* 1999; Olsen *et al.* 2000). There is significant variation in the rates of bycatch related to the types of shrimp fishing gear used. In general, the small beam trawlers, especially those that use 'low-rise' nets, tend to catch fewer Eulachon. Low-rise beam trawl nets with narrow vertical openings (the vertical distance between the lead line and the cork line) had lower rates of Eulachon bycatch than 'high-rise' nets that have larger vertical openings. The implication for this is that the vertical distribution of Eulachon might be slightly higher in the water column compared to shrimp, which would be closely associated with the bottom. In general, larger trawling vessels with 'otter trawls' (that use doors to spread the nets and thus tow at a faster speed to keep the net open), had higher bycatch rates.

Factors affecting bycatch rates are complex and poorly understood. In addition to the configuration of trawling gear, bycatch rates vary significantly with location, depth fished, season, and the use of bycatch reduction devices (BRD). Usually these are modifications to the fishing gear that allow Eulachon to escape from the top of the net before they are swept into the cod-end. In addition to the factors mentioned above, the vulnerability of Eulachon to trawl nets could depend on biotic factors, such as the availability or presence of food for Eulachon, or the presence (or avoidance) of predators. It is also possible that oceanographic factors, such as water temperature and current velocity affect bycatch rates.

The shrimp trawl industry has taken efforts to reduce bycatch through the use of BRD's, which are now mandatory. While these efforts are laudable they require more research to confirm their effectiveness, and also to determine whether or not Eulachon that escape through BRD's are injured in the process. This is seen as a vital question in other fisheries, especially those that use mid-water trawls where the small, young fish can escape through the meshes or though a BRD. For example, work by Suuronen *et al.* (1996) found very high rates of mortality, often exceeding 50 %, of young herring that escaped through trawls and other fishing gear used in the Baltic. Subsequently there has been a substantial research effort made to examine this issue in other species, which has resulted in the formation of specific committees to examine this question within the International Council for the Exploration of the Sea (ICES).

Although Eulachon bycatch in shrimp nets remains a concern, it should not preclude examination of other factors that may affect Eulachon in the marine environment, including mid-water and bottom-trawl nets used for other species. Also, the role of changes in the physical environment that affect Eulachon mortality are largely unknown. A better understanding of the marine ecology of Eulachon would provide useful information about factors affecting their distribution and abundance.

In-river fisheries also constitute a threat, especially in areas where run sizes are severely depressed and when removals are made before spawning takes place.

SPECIAL SIGNIFICANCE

Significance to First Nations

For the Nisga'a people, the Nass River Eulachon were the 'saviour' fish, arriving to the harvesting areas at a time when food from the previous year's fishing, hunting and gathering was becoming depleted. The Nisga'a Obiyee (New Year) starts during the spring equinox with the migration of Eulachon into the lower Nass River (Ksi Lisims). To this day, the Nass River Eulachon fishery is still managed under the traditional Nisga'a laws governing resource use.

Eulachon are particularly important to First Nations people. They are eaten fresh, dried, smoked, salted, and frozen whole. However, the product of greatest cultural, nutritional, social and economic value is the 'grease' rendered from the fish. Eulachon grease was produced by First Nations groups of the Central and the Northern Coasts of BC and by some First Nations groups in Alaska. The First Nations south of Knight Inlet did not produce grease but harvested the Eulachon for smoking and for fresh consumption. Eulachon grease is produced from aged or rotted fish that are cooked until the oil of the fish has separated and can be removed. The 'grease' is a very nutritious food that is high in unsaturated fats and is superior at providing vitamin A, E and K when compared to other common fat sources (Kuhnlein *et al.* 1982). The grease is used as a staple in many First Nations diets and is distributed widely in potlatches, traded with neighboring Nations and relied upon as a medicine. The importance of grease is best signified by the ancient trade routes used to link the coastal First Nations with the interior First Nations. These routes are famously referred to as "Grease Trails" as the heaviest traffic occurred during the Eulachon season to trade for the highly sought-after grease (Collison 1941).

EXISTING PROTECTION, STATUS, AND RANKS

Eulachon has not been assessed by the IUCN (IUCN, 2012). COSEWIC assessed Eulachon in the Fraser River and Central BC Coast as Endangered in 2011. On March 16, 2010, the United Stated announced that it was listing the southern Eulachon distinct population segment as threatened under its Endangered Species Act on March 10, 2010 (Department of Commerce 2010). The province of British Columbia 'blue' listed Eulachon in 2000 and maintained that listing when it was reviewed in 2004 (B.C. Conservation Data Centre, 2012).

The Nisga'a Final Agreement (NFA 1998) provides that the "Nisga'a Nation, together with any other persons who have aboriginal rights to harvest oolichan in the Nass Area, has the right to harvest the total harvest of oolichan in the Nass Area". This right to harvest is constitutionally protected and is subject only to measures that are necessary for conservation or legislation enacted for the purposes of public health and safety. The commercial sale of Nass River Eulachon is prohibited.

Since 1995 Fisheries and Ocean Canada has taken five specific activities to protect Eulachon: (i) suspension of commercial Eulachon fisheries in the Fraser River; (ii) the suspension of dredging during the Eulachon spawning season in the lower Fraser River; (iii) the closure of the shrimp fishery in Queen Charlotte Sound, the offshore area of central British Columbia; (iv) imposition of 'Eulachon action levels' by DFO management that warn of possible shrimp fishing closures when the cumulative shrimp bycatch level is achieved; (v) imposition of mandatory BRD's installed in shrimp trawls.

In response to Nisga'a concerns, commencing in 2008 DFO also closed the shrimp trawl fishery in those waters of Subareas 3-12 and 3-18 from February 1 to March 31 to avoid interaction with schooling adult Eulachon returning to spawn in the Nass River. This closure is to be reviewed annually with industry and First Nations, considering expected Eulachon returns (DFO 2011).

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